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Smoke Alarm? Solid Fuel Use May Be a Risk Factor for Mortality and Disease

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Globally, approximately 2.8 billion people are exposed to air pollution from household solid fuel use—that includes wood, coal, animal dung, and other solid materials.[1] Families who use these fuels in indoor cookstoves and heating sources are exposed to large amounts of particulate matter, especially $PM_{2.5}$, which is associated with numerous adverse health outcomes. A recent paper published in *Environmental Health Perspectives* comes from one of the first prospective cohort studies to examine solid fuel use as a risk factor for mortality and nonfatal health impacts, including cardiovascular events and respiratory disease.[2]

Part of the Prospective Urban and Rural Epidemiology (PURE) study,[3] the researchers assessed outcomes for 91,350 adults between the ages of 35 and 70 from both urban and rural communities in Bangladesh, Brazil, Chile, China, Colombia, India, Pakistan, Philippines, South Africa, Tanzania, and Zimbabwe. Participants had completed a comprehensive health assessment upon enrollment in the study. For this analysis, the individuals were then followed for an average of about 9 years, with follow-up visits that documented the development of diseases over time.

People who reported using solid fuels for cooking had, on average, higher rates of all-cause mortality, fatal and nonfatal cardiovascular disease, and fatal and nonfatal major respiratory conditions compared with people who used cleaner fuels, namely, electricity or gas. The investigators reported no difference in health outcomes between women and men. This was somewhat surprising, as women tend to do the bulk of cooking in many countries[4] and can therefore be expected to have higher air pollution exposures.

The investigators also found that risk associated with solid fuel use was lower for homes whose kitchens had a chimney and/or other types of ventilation such as windows. "This is not surprising, as ventilation will lead to decreased air pollution concentrations in the kitchen, but it is a simple message that can have important health implications," says lead author Perry Hystad, an environmental epidemiologist at Oregon State University.

"A major advantage of this prospective cohort design is that exposure [extrapolated from fuel use] was assessed before individuals developed disease," Hystad says. "The consistency of impacts . . . was surprising, even after adjusting for a comprehensive set of potential confounding factors at the individual, household,

Billions of people worldwide use solid fuels for cooking. New prospective findings suggest that replacing solid fuels with cleaner alternatives may be an important strategy to reduce premature death and disease in less affluent countries. Image: © iStockphoto/pixelfusion3d.

and community level." This study also stands out because of its geographical diversity (467 communities in 11 countries) and its size; many previous studies were restricted to one community and were not large enough to assess nonfatal impacts.

"It has largely been assumed that the cardiovascular impacts of household air pollution are similar to outdoor air pollution, but the scientific evidence to support that assumption is extremely limited," says Jill Baumgartner, an associate professor of epidemiology at McGill University, who was not involved in the research. "This study provides important new evidence that replacing solid fuel cookstoves with gas and electric stoves may be an [effective] intervention for reducing cardiovascular disease burden in low- and middle-income countries."

Baumgartner points out that the investigators based their exposure estimates on the primary fuel that individuals reported using. But in past studies, primary fuel use has correlated poorly with measured exposures to air pollution. That's possibly because people who report using gas or electricity as their primary fuel may also use dirtier-burning solid fuels. In the absence of residual confounding and misclassification of exposure, the benefits of cleaner fuels reported in this study may actually be underestimated.

"This is a strong study that contributes to an important evidence gap regarding household solid fuel use and mortality and incident cardiovascular and respiratory disease," says Cathryn Tonne, an associate research professor at the Barcelona Institute for Global Health, who also was not involved in the research. "The literature on this topic is still surprisingly small considering the large number of people that continue to rely on solid fuel for cooking and [the] large public health burden."

Tonne also points to the link[4] between solid fuel use and poverty. "[These two factors] are very difficult to disentangle in terms of which is driving the health effects," she says. "This is why we need better air pollution exposure assessment rather than just relying on fuel use indicators."

As far as future research directions, Hystad and colleagues recently completed monitoring $PM_{2.5}$ pollution in 4,000 PURE participant homes in eight countries. "We will be using this information to get a better understanding of actual $PM_{2.5}$ exposures from cooking with solid fuels," he says. "Moving beyond a crude indicator of using solid fuels for cooking to estimated $PM_{2.5}$ concentrations will be important to further understanding household air pollution impacts on chronic disease."

Wendee Nicole has written for *Discover*, *Scientific American*, and other publications.

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